DIY

Worthwhile projects you can build on your own

40/80-meter NVIS Antenna

Did you install a highly recommended HF antenna, purchase a nice HF rig, fire it up, only to find people you know in your town, your county, or even in Utah couldn't hear you? To make matters worse, you can barely hear them too. What's going on? Well, before you request a refund on your radio and scrap your antenna, maybe a change in just your antenna can make a difference.

During World War II the military often depended on short-ranged (a few dozen miles) AM radio communication, which is subject to several major limitations, including excessive noise, inability to penetrate foliage, huge power requirements, and sheer equipment weight. Often they needed communication for a much wider area, and SSB (single sideband) over HF (high frequency) allowed them to really get their signal out using less power. More often than not, however, the resulting signals overshot their targets, and could be heard thousands of miles away, but if they only needed to reach their command centers located 150 to 300 miles away, they were in trouble.

The military figured that, if they could get much of their signal to shoot straight up into our ionospheric dome, it would get reflected back down, but over a slightly wider area. Because the incidence (angle of transmission) would be nearly vertical, and the actual radio waves used for the communication were *skywave* (reflected from the atmosphere), it became known as *near vertical incidence skywave*, or NVIS, nicknamed *cloud-warmer*. This method of transmission resulted in communicating with ground stations 100 to 400 miles away, ***on 40 meters during the day and 80 meters at night***. Let's explore how to construct just such an antenna.

An NVIS antenna is nothing more than a Yagi antenna aimed straight up, and consists of a pair of dipole driven elements and a reflector element. So, essentially we're talking three wires, coax, appropriate connector, and support. Let's start with a shopping list:

110 feet of 18 AWG speaker wire

1 x 50-foot RG-8X coax with PL-259 ends

2 x 10-foot 1" Schedule 80 PVC

1 x 6" of 1-1/4" PVC tubing

1 x 10-inch section of 4" PVC

4 x #6 3/4" beveled machine screws

1 x 16 AWG ring lug

4 x metal camping stakes

1 x SO-239 bulkhead connector

3 x 4-foot sections of rebar

6 x 1" PVC slip couplings

1 x 4-foot 1/2" Schedule 40 PVC

Zip ties, paracord

4 x #6 nuts and lock washers

4 x plastic camping stakes

Speaker wire

PVC slip coupling

SO-239 bulkheads

DIY, continued

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This particular 40/80-meter NVIS design is attributed mostly to Steve Brumagin, KI4VGA.

Center divider

In the 1-1/4" PVC tubing drill a 3/8" hole in the center, and four 1/8" holes, one at one inch from the end, and another at two inches from the end, on each side of the 3/8" hole, with all five holes in a straight line. Cut a 35-foot length of the speaker wire and unzip it to separate the two conductors. Slip one of the two wires through the inside of the tubing, out through one of the 1/8" holes that's two inches from the end, then back into the hole that's one inch from the end, then out the large hole. Repeat this with the other wire on the other side. Solder and/or crimp the lug on one of the two wires protruding from the large hole.

Insert the SO-239 bulkhead into the large hole to measure, then drill out the four small bulkhead screw holes in the PVC tubing. Solder the wire without the lug to the center pin of the SO-239 bulkhead. Attach the SO-239 bulkhead to the PVC tubing, connecting the lug to one of the inside bulkhead screws. Cut four two-inch sections of the 1/2" PVC and drill two opposing 1/4" holes about 1/2" from each end of all four tubes. Loop the end of each wire through two end holes of one of the two-inch tubes, and zip-tie the wires so that the entire length of each wire is about 33 feet 6 inches.

Separators

Cut five 5" sections of the 1/2" PVC, and drill two opposing 1/4" holes about 1/2" from each end of all five tubes. Cut a 76-foot length of the speaker wire and unzip it to separate the two conductors. String each wire through one pair of holes in each five-inch tube. Loop the end of each wire through two end holes of one of the two-inch tubes, and zip-tie the wires so that the entire length of each wire is about 75 feet or less. Attach a zip tie through the holes of the other end of the four two-inch tubes, and stake down the two long, parallel wires with plastic stakes.

DIY, continued

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Vertical support

Drive one of the rebar one to two feet into the ground in the middle, between the two long, parallel wires. Drive the other two rebar into the ground about 81 feet apart from each other (40 feet 6 inches from the center rebar.) Cut six three-foot sections of Schedule 80. Drill two opposing 1/4" holes about an inch from each end of three of the six Schedule 80 sections. Slip one of the non-drilled Schedule 80 sections onto each rebar. Slip a 1" PVC coupling onto the top end of each non-drilled Schedule 80 section. Slip the non-drilled end of the drilled Schedule 80 section into each 1" PVC coupling.

Radiator and isolator

Use paracord to guy the top of each drilled Schedule 80 section to two metal stakes. Use paracord to stretch each top 33 feet 6 inch wire to its drilled Schedule 80 section, trying to keep it from drooping as much as possible. Attach the 1-1/4" PVC center section to the center Schedule 80 section. Connect the coax to the SO-239 bulkhead, then tie-wrap the coax along the center Schedule 80 section all the way to the ground. About a foot away from the two long, parallel wires wind ten turns of the same coax around the 4" PVC for an RF isolator, and drill holes in the 4" PVC in the appropriate places for zip ties, then apply zip ties to hold the isolator in place.

Using the antenna

The impedance of your NVIS antenna will not be ideal, due to its proximity to the ground and other factors, so plan on using a tuner with it. Also, the radiating element couples easily with nearby metallic objects at 40 meters, so be sure to keep metal objects at least eight feet away. One last thing to keep in mind: if you're going to use NVIS to communicate effectively with another nearby station on 40 or 80 meters, the other station will also need to use an NVIS antenna, or the QSO might end up being very one-sided.

Good luck!